Privatization Waves

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Abstract

We investigate a mixed economy where state-owned public enterprises compete against private firms. We examine sequential privatization of public enterprises, and find that under plausible assumptions one privatization increases the welfare gains of the subsequent privatizations. Thus, even if privatization does not improve welfare at the early stages, it can eventually lead to a point such that privatizations after that point on are beneficial to the society and the privatization program ends up with a success.

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1 Introduction

Since the nineteen eighties we have observed a worldwide wave of privatization of state-owned public enterprises. Nevertheless, public firms still exist, and many of them compete with private firms in private goods markets. Competition between public and private firms existed, or still exists, in a range of industries including the airline, rail, telecommunications, natural gas, electricity, steel, and overnight-delivery industries, as well as services including banking, home loans, health care, life insurance, hospitals, broadcasting, and education. How privatization of these public firms affects welfare is still an important issue in many developed, developing, and former communist transitional countries.

Recently, studies of 'mixed markets', involving both private and public enterprises, have become increasingly popular.[1] Most works assume that the public firm maximizes social welfare (the sum of consumer surplus and profits by firms) while the private firm maximizes its own profits. In their pioneering work, De Fraja and Delbono (1989) show that in the context of a quantity-setting oligopoly, welfare may be higher when a public firm is a profit-maximizer rather than a welfare-maximizer. Thus, privatization of a public firm may improve welfare even without improving the managerial efficiency of the public firm.[2] This result suggests that in

[1] This interest in mixed oligopolies is due to their importance to the economies of many countries, except for the United States. Although they are less significant in the United States, there are some examples of mixed oligopolies such as the packaging and overnight-delivery industries. See Bös (1986, 1991) for surveys. The idea of mixed oligopoly dates at least to Merrill and Schneider (1966). Recently, the literature on mixed oligopoly has become richer and more diverse. For example, Ishibashi and Matsumura (2006), Nishimori and Ogawa (2002), and Poyago-Theotoky (1998) investigate R&D competition between public and private sectors. Mujumdar and Pal (1998) consider tax effects. Bárcena-Ruiz and Garzón (2005a,b) investigate policy interaction between market integration and privatization policy. Corneo and Jeanne (1994), Fjell and Pal (1996), Pal and White (1998), and Matsushima and Matsumura (2006) investigate international competition. Bárcena-Ruiz and Garzón (2003, 2006) discuss a merger problem. Ohori (2006) and Bárcena-Ruiz and Garzón (2006) analyze environmental policies. Lee (2006) investigates a vertical relationship. Lee and Hwang (2003) investigate an agency problem. Anderson et al. (1997), Futagami (1999), and Matsumura and Kanda (2005) investigate a long-run competition. Pal (1998), Matsumura (2003a,b), Lu (2006), and Bárcena-Ruiz (2007) discuss endogenous role. Cremer et al. (1991), Kumar and Saha (2007), Li (2006), and Matsushima and Matsumura (2003) analyze endogenous product differentiation. All of these works, however, investigate models with single public enterprise.

[2] Later, Matsumura (1998) shows that under moderate conditions the welfare-maximizing behavior by the

some cases a public firm should be privatized and maximize profits rather than welfare.

Most works in this field assume that the number of public firms is one. However, in the real world there are economies with more than one public firm, and many privatization programs include privatizations of several public enterprises. Therefore, the assumption of one public firm is quite restrictive. In models with just one public firm, privatization of the public firm yields pure market economies. In many of communist or former communist transitional countries such as China, Russia, and East European countries, as well as traditional mixed economies such as UK, France, Canada, Japan, India, Brazil, and Thailand, even after privatization of a single public firm, many other public firms would still remain in the market.[3] Thus, the implication of privatization of a single public firm must be quite different in these countries. Even if the huge single public sector holds many departments, it is possible and in fact realistic that it sells one plant to private sectors and still holds other plants. In this case, the partial privatization above does not yield the pure market economy and the public enterprise still plays an important role after this privatization. Most of existing works cannot evaluate these situations appropriately. To evaluate the privatization programs in these countries, we must deviate from the framework of traditional models involving single public firm with single department.

In this paper we examine an N firm oligopoly, where m out of N are public firms.[4] We investigate how the number of public firms $m(\leq N)$ affects the total social surplus W. We find that if the public firms are sufficiently inefficient compared to the private firms, privatization always improves welfare. We also find that if firms are not too inefficient and N is small

public firm is not optimal if we allow partial privatization, and that partial privatization usually improves welfare. For partial privatization, see also Bös (1986), Fershtman (1990), Fujiwara (2006, 2007), and Lu and Poddar (2007).

[3] The typical examples are banking sectors in Japan, Germany, and India. Energy market in EU is another example. Many sectors in China are also important examples.

[4] Instead of considering m independent public firms, we can formulate the following alternative model yielding exactly the same results: One huge public sector holds m plants. Each of $N - m$ private firms holds one plant. The privatization of one public firm in the model corresponds to the situation that the public sector sells one plant to a new private entrant in the alternative model.

enough, privatization is always harmful to welfare. A smaller N implies that the market is less competitive. This results states that, if the market is not competitive, a privatization program impairs welfare (so the program might not succeed). Thus, the government should improve the competitiveness of the market concurrently with or before the start of the privatization program.

Given that the public firms are not relatively too inefficient, if N is large enough, there exists $\hat{m}$ such that the total social surplus $W(m)$ is decreasing (increasing) in m for $m < \hat{m}$ ($m > \hat{m}$). This implies that privatization improves welfare when the number of public firms is small. We also find that $W(m)$ is convex with respect to m for $m < \hat{m}$ in this case (See Figure 1).

This result contains rich implications. Suppose that the government plans to privatize the public firms sequentially. If the initial number of public firms exceeds $\hat{m}$, privatization initially causes welfare to be impaired. However, repeated privatization would eventually lead to a point such that privatization after that point on is beneficial to the society. Furthermore, the welfare gain becomes increasingly larger at the later stages since $W(m)$ is convex. This result contains another implication. Suppose that the government plans to privatize $m'(< m)$ public firms and $m > \hat{m}$. Our results imply that a larger scale privatization (a larger m') more likely improves welfare. Thus, it might be better to expand rather than shrink the privatization program even when the small scale privatizations may fail to improve welfare.[5]

Finally, the assumption that the public firms maximize welfare implies that the owner (government) of the public firms is a welfare-maximizer and there is no agency problem in the public firms. This assumption is adopted intentionally to stress our purpose, which is to show that even under ideal situations for public firms above, privatization of a public firm improves welfare and the welfare-gain of the sequential privatization is accelerating under plausible conditions.

The remainder of this paper is organized as follows. In Section 2 we formulate the model. Section 3 investigates the equilibrium in mixed economy. Section 4 presents the results. Section 5 concludes the paper.

[5] Czech had a successful experience with a rapid and large scaled privatization program. On the other hand, Romania and Hungary experienced failure with slow and small scaled privatization programs at the early stages of the transition.

2 The model

We formulate a mixed oligopoly model with N firms, of which m are state-owned public firms (firms 1, 2, ..., m) and $N-m$ are private firms (firms $m+1$, ..., N). All firms produce perfectly substitutable commodities for which the market demand function is given by $p(Q) = a - Q$, where a is a positive constant, p is the price, and Q is the total output. Let the cost function of state-owned public firm i ($i \in \{1, 2, ..., m\}$) be $c_i(q_i) = K + (1/2)\alpha q_i^2$, and that of private firm i ($i \in \{m+1, ..., N\}$) be $c_i(q_i) = K + (1/2)\beta q_i^2$, where $K \geq 0$, $\alpha \geq \beta \geq 0$ and $\alpha > 0$.[6]

Social welfare W is the sum of consumer surplus and firms' profits, and is given by

$$W = \int_0^Q p(q)dq - pQ + \sum_{i=1}^{N} \Pi_i = \int_0^Q p(q)dq - \sum_{i=1}^{N} c_i(q_i), \tag{1}$$

where Π_i ($i = 1, ..., n$) is firm i's profit, q_i is firm i's output quantity, and Q is the total output given by $Q \equiv \sum_{i=1}^{N} q_i$.

The game runs as follows. Firms simultaneously and independently decide the production level and compete in a Cournot fashion. Each private firm's objective is to maximize its own profit. On the other hand, each public firm's objective is to maximize welfare W.

[6] We allow both the case where public firms are less efficient than the private firms ($\alpha > \beta$) and the case where public firms are as efficient as the private firms ($\alpha = \beta$.) Whether or not the public firms are less efficient than the private firms is a controversial issue. Some empirical works support the former view and other works support the latter. Thus, we assume $\alpha \geq \beta$ to allow both cases. However, we believe that the assumption that $\alpha = \beta$ is realistic only when m is considerably small compared to N. In the mixed market where a substantial number of private firms exists, public firms receive competitive pressure at the product markets, and this would force the public firms to be as efficient as private firms. However, if m is close to N and the economy is closer to planned economy than market economy, competitive pressure at the product market becomes negligible and the assumption that $\alpha = \beta$ loses its reality. Thus, when we discuss the case where $\alpha = \beta$, our attention is restricted to the case where m is considerably small relative to N. For the discussion of the efficiency of public firms, see Megginson and Netter (2001), Mizutani and Uranishi (2003), and Stiglitz (1988). See also Martin and Parker (1997) who suggest that the change in corporate performance went both ways after privatization in the UK. For discussion of endogenous cost differences between public and private firms, see Bös and Peters (1995), Corneo and Rob (2003), Matsumura and Matsushima (2004), and Nett (1993, 1994).

3 Equilibrium

We solve for the Cournot-Nash equilibrium of this game. The first order conditions of welfare/profit maximization for the public/private firms, respectively, are given by

$$\frac{\partial W}{\partial q_i} = 0 \iff a - \sum_{k=1}^{N} q_k - \alpha q_i = 0, \quad i = 1, \cdots, m. \text{ (public firms)}$$

$$\frac{\partial \Pi_j}{\partial q_j} = 0 \iff a - \sum_{k=1}^{N} q_k - (1+\beta) q_j = 0, \quad j = m+1, \cdots, N. \text{ (private firms)}$$

The second order conditions are satisfied. We can show that the equilibrium is symmetric, i.e., $q_1 = q_2 =, \cdots, = q_m$ and $q_{m+1} =, \cdots, = q_N$ in equilibrium. Let q^{s*} denote the equilibrium output of each state-owned public firm and q^{pr*} denote the equilibrium output of each private firm. Solving the first order conditions we have the equilibrium outputs:

$$q^{s*} = \frac{(\beta+1)a}{\alpha(N-m) + (\alpha+m)(\beta+1)}, \quad q^{pr*} = \frac{\alpha a}{\alpha(N-m) + (\alpha+m)(\beta+1)}.$$

From this result, we obtain the following as the equilibrium total output, price, and welfare, respectively.

$$\begin{aligned} Q^* &= \frac{\{m(\beta+1) + (N-m)\alpha\}a}{\alpha(N-m) + (\alpha+m)(\beta+1)}, \qquad p^* = \frac{\alpha(\beta+1)a}{\alpha(N-m) + (\alpha+m)(\beta+1)}, \\ W^* &= \frac{[m(\beta+1-\alpha)(m+2\alpha N) + \alpha\{(\beta+1)^2 - \alpha(\beta+2)\}m + N(N+\beta+2)\alpha^2]}{2\{\alpha(N-m) + (\alpha+m)(\beta+1)\}^2} a^2 - NK. \end{aligned}$$

4 Privatization

In this section, we consider the effects of privatization of some or all of the public firms. We investigate the relationship between W^* (equilibrium social welfare) and m (the number of public firms).

Proposition 1: *If $\alpha \geq (\beta+1)^2/(\beta+2)$, then W^* is non-increasing in m, and in this case, $\partial W^*/\partial m = 0$ if and only if $m = N$ and $\alpha = (\beta+1)^2/(\beta+2)$.*

Proposition 2: *If $\alpha < (\beta+1)^2/(\beta+2)$ and*

$$N \leq \frac{(\beta+1)^3 - \alpha(\beta+1)(\beta+2)}{1 - \beta^2 + \alpha\beta}, \tag{2}$$

then W^* is non-decreasing in m, and in this case, $\partial W^*/\partial m = 0$ if and only if $m = 0$ and (2) holds with equality.

Proposition 3: *If $\alpha < (\beta+1)^2/(\beta+2)$ and (2) is not satisfied, then (i) W^* is decreasing in m for $[0, \hat{m})$, is minimized at $\hat{m}$, and is increasing in m for $(\hat{m}, N]$ where*

$$\hat{m} = \frac{\alpha[N(\beta^2 - \alpha\beta - 1) + (\beta+1)^3 - \alpha(\beta+1)(\beta+2)]}{(\beta+1-\alpha)\{\alpha\beta - (\beta+1)^2\}} \in [0, N].$$

and (ii) W^* is convex with respect to m for $[0, \hat{m}]$.

Proofs of Propositions 1–3: See Appendix.

Proposition 1 states that if public firms are sufficiently inefficient compared to the private firms, any privatization always improves welfare. The intuition and policy implications of Proposition 1 are so clear that we skip the detailed explanations. Henceforth, we discuss the case where $\alpha < (\beta+1)^2/(\beta+2)$.

We discuss policy implications derived from Propositions 2 and 3. A smaller N implies that the market is less competitive. Proposition 2 states that, if the market is not competitive, a privatization program impairs welfare (so the program might not succeed). This result indicates that the government should improve the competitiveness of the market as it proceeds with the privatization program.

Proposition 3 itself contains rich policy implications. Suppose that the market has already been competitive and (2) is not satisfied. Suppose also that the initial number of public firms is m_3 in Figure 1. Consider now the situation where the government plans to privatize the public firms sequentially. This privatization program reduces total surplus at the early stages, until the number of public firms reaches $\hat{m}$. After this point on, privatization begins to improve welfare. Furthermore, we have from Proposition 3(ii) that the welfare gain is greater at the later stages.

Proposition 3 contains another implication. Suppose that the government plans to reduce the number of public firms by privatizations from m_3 to m_1 (program 1) or to m_2 (program 2), where $m_1 < m_2 < \hat{m}$ (see Figure 1). Our result implies that a larger scale privatization program (program 1) more likely improves welfare than a smaller scale one (program 2). Thus,

it would be better to expand rather than shrink the privatization program even if the small scale privatization does not improve welfare at first.

Again, we emphasize an important policy implication of Propositions 1–3. If $W^*(m) < W^*(m-1)$, then $W^*(m-1) < W^*(m-2)$ must hold. In other words, if one privatization improves welfare, subsequent privatizations always improve welfare. However, the reverse is not true. Even if $W^*(m) > W^*(m-1)$, $W^*(m-2) > W(m) > W^*(m-1)$ can hold.

Next, we explain the intuition behind Propositions 2 and 3. The key is production substitution from public firms to private firms.The first order condition of firm 1 (public firm) is $p = c_1'$ and that of firm N (private firm) is $p = -p'q_N + c_N' > c_N'$. Thus, in equilibrium the public firm's marginal cost is higher than private firm's. Suppose that $m = 1$ (only firm 1 is public) and firm 1 is privatized. This privatization decreases firm 1's output and increases $N-1$ private firms' outputs. Since firm 1's marginal cost is higher than the others', this production substitution saves total production costs and this effect is strong when the number of private firms is large. At the same time, privatization also reduces total outputs Q, which reduces consumer surplus, resulting in the loss of welfare. Privatization improves welfare if the welfare-improving production substitution effect dominates the other effect. The larger the number of private firms is, the smaller the increase in production costs by private firms is. Thus, welfare-improving production substitution effect is stronger when $N-1$ is large. This is why privatization does not improve welfare when N is small.

Suppose that $m > 1$ (firm 1, firm 2, ..., and firm m are public) and firm m is privatized. This privatization decreases firm m's output and increases $N-m$ private firms' outputs and $m-1$ public firms' output. Thus, when $m > 1$, privatization of firm m induces both positive (welfare-improving) production substitution (from firm m to private firms) and negative (welfare-worsening) production substitution (from firm m to public firms). The larger m is, the weaker the former positive effect is. This is why one privatization increases the welfare gain of the subsequent privatizations.

5 Concluding remarks

In this paper we investigate a model in which state-owned public firms compete against private firms. We find that the welfare gain of privatization of one public firm is greater when the number of remaining public firms is small. This implies that privatizations of all public firms can be welfare-improving even if privatization of just one public firm is not beneficial. This highlights the problem that sequential privatizations of public firms confront. At the early stages, privatization may not seem to be beneficial, and the privatization might face strong oppositions. However, repeated privatization would eventually lead to a point such that privatization after that point on is beneficial to the society. Furthermore, welfare gain is greater at the later stages in such cases. Thus, the privatization program should not be abolished even if privatization does not seem beneficial at first.

In this paper we assume that the production efficiency of public firms, α, is constant and does not depend on m and N. This assumption might be problematic. When m is small and N is large, competitive pressure at the product markets might force the public firms to be as efficient as private firms and α might be close to β. However, if m is close to N and the economy is closer to the planned economy rather than market economy, competitive pressure becomes negligible, resulting in the significant level of X-inefficiency. Thus, it might be realistic to assume that α depends on m and N, or to endogenize α and β. These issues remain for future research.

Appendix

Proof of Proposition 1 Taking the first order derivative of W with respect to m yields

$$\frac{\partial W}{\partial m} = \frac{\alpha a^2 f(m)}{2\{\alpha(N-m)+(\alpha+m)(\beta+1)\}^3}, \tag{3}$$

where

$$f(m) = m(\beta+1-\alpha)\{(\beta+1)^2-\alpha\beta\} + \alpha\{N(\beta^2-\alpha\beta-1)+(\beta+1)^3-\alpha(\beta+1)(\beta+2)\}. \tag{4}$$

Since the denominator of (3) and αa^2 in the numerator of (3) are positive, the sign of (3) is equal to that of (4). Since $f(m)$ is linear with respect to m, it is monotone.

Suppose that $\alpha > \beta+1$. Since $f(m)$ is monotone, $f(m)$ is maximized either when $m = N$ or when $m = 0$. Note that $0 \le m \le N$. Substituting $m = N$ into (4) yields

$$f(N) = (\beta+1)(\alpha+N)\{(\beta+1)^2-\alpha(\beta+2)\}. \tag{5}$$

We have $f(N) < 0$ when $\alpha > \beta+1 > (\beta+1)^2/(\beta+2)$. Substituting $m = 0$ into (4) yields

$$f(0) = \alpha\{N(\beta^2-\alpha\beta-1)+(\beta+1)^3-\alpha(\beta+1)(\beta+2)\}. \tag{6}$$

Since we have $\beta^2-\alpha\beta-1 < \beta^2-(\beta+1)\beta-1 = -\beta-1 < 0$ and $(\beta+1)^3-\alpha(\beta+1)(\beta+2) < (\beta+1)^3-(\beta+1)^2(\beta+2) = -(\beta+1)^2 < 0$, we have $f(0) < 0$. Thus, (3) is negative if $\alpha > \beta+1$.

Suppose now that $\alpha \le \beta+1$. In this case we know that $f(m)$ is non-decreasing in m since $(\beta+1)^2-\alpha\beta \ge (\beta+1)^2-(\beta+1)\beta = (\beta+1) > 0$, so $f(m)$ is maximized when $m = N$. Equation (5) implies that $f(N) \le 0$ if and only if $\alpha \ge (\beta+1)^2/(\beta+2)$. Thus, (3) is non-positive, and it is zero if and only if $\alpha = (\beta+1)^2/(\beta+2)$ and $m = N$. Note that $f(m)$ is strictly increasing in m when $\alpha = (\beta+1)^2/(\beta+2)$. **Q.E.D.**

Proof of Proposition 2 Suppose that (2) is satisfied. As $\alpha < (\beta+1)^2/(\beta+2) < \beta+1$, $f(m)$ in (4) is increasing in m. Since the sign of (3) is equal to that of (4), all we have to show is that $f(0) \ge 0$. Solving

$$f(0) \ge 0 \Longleftrightarrow N(\beta^2-\alpha\beta-1)+(\beta+1)^3-\alpha(\beta+1)(\beta+2) \ge 0$$

with respect to N yields (2). Note that $f(m) = 0$ (so (3) is zero) if and only if $m = 0$ and (2) holds with equality. **Q.E.D.**

Proof of Proposition 3(i) Suppose that $\alpha < (\beta+1)^2/(\beta+2)$ holds and (2) is not satisfied. Since $\alpha < (\beta+1)^2/(\beta+2) < \beta+1$, $f(m)$ in (4) is increasing in m. Thus, all we have to show is that $f(0) < 0$ and $f(N) > 0$. In the proof of Proposition 1 we have already shown that $f(N) > 0$ if $\alpha < (\beta+1)^2/(\beta+2)$. In the proof of Proposition 2 we have already shown that $f(0) < 0$ if (2) is not satisfied. Solving the equation $f(m) = 0$ we have that

$$\hat{m} = \frac{\alpha[N(\beta^2 - \alpha\beta - 1) + (\beta+1)^3 - \alpha(\beta+1)(\beta+2)]}{(\beta+1-\alpha)\{\alpha\beta - (\beta+1)^2\}}. \quad \textbf{Q.E.D.}$$

Proof of Proposition 3(ii) We show the following lemma (Lemma A1). Lemma A1 and Proposition 3(i) imply Proposition 3(ii).

Lemma A1: *Suppose that $\alpha < \beta + 1$. If $\frac{\partial W}{\partial m}\Big|_{m=\tilde{m}} \leq 0$ for $\tilde{m} \in [0, N]$, then $\frac{\partial^2 W}{\partial m^2}\Big|_{m=\tilde{m}} > 0$ holds.*

Proof Suppose that $\frac{\partial W}{\partial m}\Big|_{m=\tilde{m}} \leq 0$. From (3), we have

$$f(\tilde{m}) = \tilde{m}(\beta+1-\alpha)\{(\beta+1)^2 - \alpha\beta\} + \alpha\{N(\beta^2 - \alpha\beta - 1) + (\beta+1)^3 - \alpha(\beta+1)(\beta+2)\} \leq 0. \quad (7)$$

Differentiating (3) with respect to m yields

$$\begin{aligned}\frac{\partial^2 W}{\partial m^2} &= \frac{\alpha(\beta+1-\alpha)a^2}{\{\alpha(N-m) + (\alpha+m)(\beta+1)\}^4}\Big[-m(\beta+1-\alpha)\{(\beta+1)^2 - \alpha\beta\} \\ &\quad +\alpha\{N(-\beta^2 + \alpha\beta + \beta + 2) - (\beta+1)^3 + \alpha(\beta+1)(\beta+3)\}\Big], \qquad (8)\end{aligned}$$

Manipulating (8) using (7) after setting $m = \tilde{m}$ yields

$$\frac{\partial^2 W}{\partial m^2}\Big|_{m=\tilde{m}} \geq \frac{\alpha^2(\beta+1-\alpha)(N+\alpha)(\beta+1)a^2}{\{\alpha(N-\tilde{m}) + (\alpha+\tilde{m})(\beta+1)\}^4} > 0. \quad \textbf{Q.E.D.}$$

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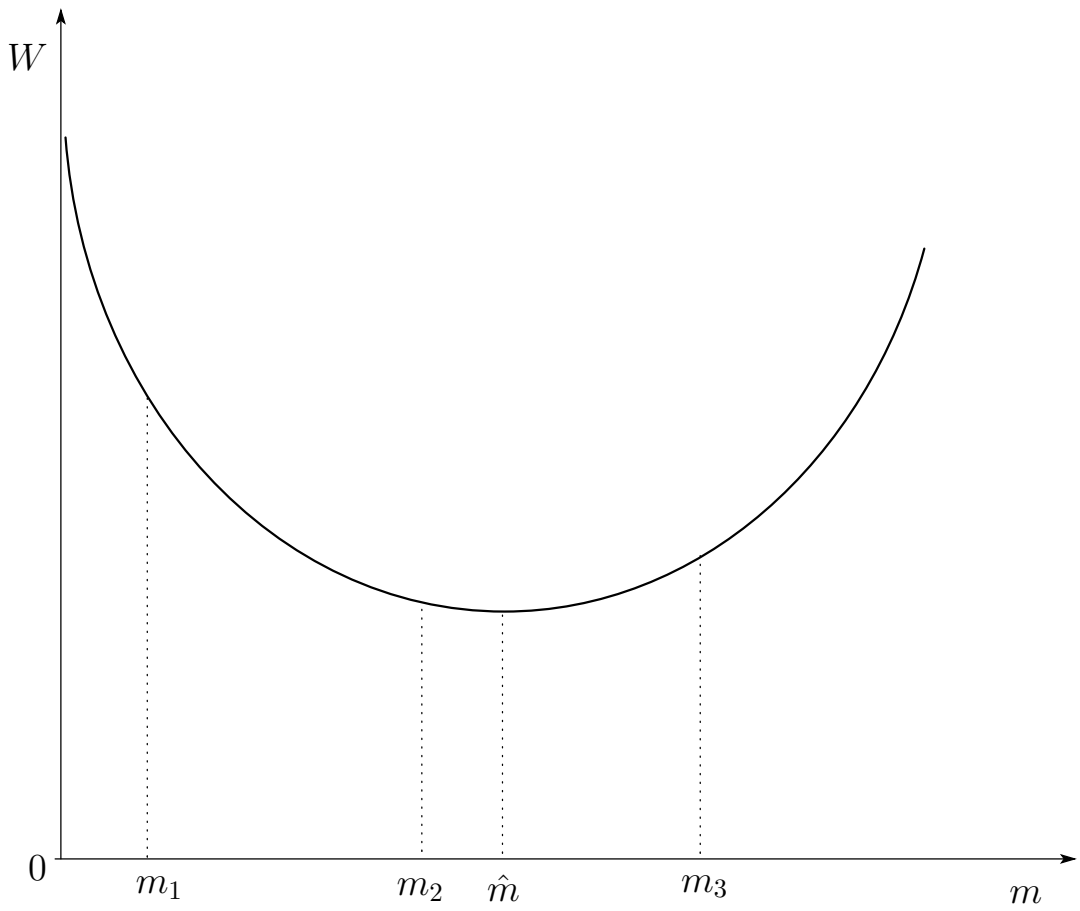

Figure 1